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Effect of irrigation techniques and planting methods on yield and water productivity of cumin (*Cuminum cyminum* L.)

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Abstract

In order to evaluate the effect of irrigation techniques and planting methods on yield and yield components of cumin (*Cuminum cyminum* L.) under semi-arid conditions of Rajasthan in India, a factorial arrangement of a split plot design with four replications was conducted. Three irrigation techniques viz., surface irrigation, drip and micro sprinkler in main plot and three sowing methods viz., flat bed, raised bed 75 cm (normal bed) and wider raised bed 150 cm in sub plots were applied. According to result, seed yield was influenced by irrigation methods and land configuration. Iirrigation with drip gave higher seed yield followed by micro sprinkler and lowest with surface (flood) irrigation. Among the land configuration, sowing of 3 rows of cumin on raised beds (75 cm) not only enhanced the yield but also improved the water productivity in cumin.

Key words: Cumin, micro irrigation, drip irrigation, land configuration, raised bed

Introduction

India is the largest producer, consumer and exporter of cumin in world market. Rajasthan and Gujarat are the leading cumin growing states in India. Being a *rabi* crop, cumin is sown from last week of October and continues till the first fortnight of November and the crop is harvested in the month of March and the peak arrivals in market are during March-April. In semiarid area such as India and other mediterian regions, water is the most limiting factor for farming. In absence of new irrigation projects, bringing more area under irrigation would mostly rely on the efficient use of water. In this context, micro irrigation could play a key role in higher productivity and increased water use efficiency (WUE). Besides this, adoption of micro irrigation system might help in raising the irrigated area and productivity of crops. Cumin is highly sensitive to water stagnation. Light irrigation under surface irrigation method create anaerobic conditions for few hours may severely affect the fully developed plants. Winter rains further aggravated the problem due to super saturation of the root zone. Furrow irrigated raised beds (FIRB), wherein irrigation water will reach in the root zone by lateral movement and does not allow to create anaerobic condition which may help for better growth and yield of cumin. The bed surface remains almost dry and the lateral water movement fulfils the crop water requirement. This system is often considered more appropriate for growing high value crops that are more sensitive to temporary water logging stress.

Materials and methods

The experiment was conducted in 2010-11 and 2011-12 at Research Farm, ICAR-NRC on Seed Spices, Tabiji, Ajmer, Rajasthan (74° 35´E longitude, 26° 22´ N latitude and 460.17 m altitude). Long term average precipitation was 456 mm and this area is semiarid according to De Martonne classification. The soil texture at the experimental area was sandy loam (PH=8.2 and EC= 1.2 mmhos/ cm) having 0.25% organic carbon and 176.8, 33.4 and 234.0 kg/ha available N, P_2O_5 and K_2O, respectively. The treatments comprising of three irrigation methods (surface irrigation, drip and micro sprinkler) in main plot and three land configurations (flat bed, raised bed 75 cm (normal bed) and wider raised bed 150 cm) in sub plot replicated four times in split plot design. Cumin variety GC-4 was sown on 25-11-2010 and 11-11-2011 at 25 cm row spacing using 12 kg/ha seed rate after treating with bevistin and *Trichoderma* using 2.5 and 4.0 g/kg seed. Three and six rows were accommodated on raised bed having 45 and 100 cm upper width of the raised bed, respectively. Whereas spacing between two furrows were 75 and 150 cm in normal and wider beds, respectively. For each set of three rows of the crop, one line of lateral having inline drippers at 30 cm distance was placed along the central row of the crop. The drip line was made of LLDPE having 16 mm diameter and operated at 1.0 kg/cm^2 pressure with the discharge rate of 2.2 litre/hr. In micro sprinkler, 20 mm size laterals installed with sprinklers having 16 litre/hr discharge at 1.0 kg/cm^2 pressure connected

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through 12 mm diameter flexi tubes and 45 cm high HDPE stakes at 2.0 meter interval. Four irrigations were given to the crop measuring 19.44, 5.12 and 5.43 ha cm water through surface irrigation, drip and micro sprinkler systems during 2010-11 and five irrigations were given to the crop measuring 30.61, 10.64 and 15.55 ha cm water through surface irrigation, drip and micro sprinkler systems during 2011-12. Whereas 10.73, 8.81 and 10.45 ha cm during 2010-11 and 19.62, 17.68 and 19.49 ha cm water during 2011-12 was delivered under flat, raised beds (75 cm) and wider beds (150 cm). Half of the recommended dose of N (30 kg/ha) and full dose of P (20 kg/ha) was applied as basal dose. Remaining half of N was given in two equal splits at 30 and 60 DAS. The crop was harvested on 25-03-2011and 22-03-2012 and threshed manually. Five plants were selected randomly from each plot and observations on plant height, primary branch/ plant, secondary branch/ plant, umbel/ plant, umbellate/ umbel, no of seeds/ umbellate, test weight (g) and yield kg/ha were recorded at harvest from each plot.

Results and discussion

Results show that irrigation with micro sprinkler and drip irrigation enhanced the yield by 177.7 and 85.8 kg/ha during 2010-11 and 79.1 and 180.3 kg/ha during 2011-12. The water productivity was also improved by 47.8 and 33.1 kg grain/ha cm water during 2010-11 with micro sprinkler and drip irrigation; 13.28 and 32.85 kg grain/ha cm with micro sprinkler and drip irrigation during 2011-12 than flood irrigation methods (Table 1). Among sowing methods, sowing of 3 rows of cumin on raised beds (75 cm) and 6 rows of cumin on wider raised beds (150 cm) enhanced the seed yield by 62.28 and 42.23 % during 2010-11 and 74.58 and 2.51 % during 2011-12 than flat bed. Similarly, water productivity was improved by 16.6 and 7.7 kg grain/ha cm irrigation water during 2010-11 and 15.1 and 1.5 kg grain/ha cm irrigation water during 2011-12 with sowing of 3 rows of cumin on raised beds (75 cm) and 6 rows of cumin on wider raised beds (150 cm) as compared with flat beds. Heidari Zolleh *et al.*, 1 show that early sowing date resulted in higher seed yields that can be explained by higher above ground biomass, number of umbel per plant, number of seed per umbel and plant height. Singh *et. al.* 2 also reported higher water productivity and yield of cumin sown on raised bed with drip irrigation. Hence, it is inferred from the above study that cumin crop should be sown on raised beds (75 cm) with drip irrigation or micro sprinkler irrigation method for higher yield and water productivity.

References

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Irrigation techniques (Drip and micro sprinkler on raised beds (75 and 150 cm)

Land configuration (flat bed, raised bed having 75 and 150 cm)

Table 1: Effect of irrigation methods and sowing methods on yield and water productivity of cumin during 2010-11 and 2011-12

Treatment	2010-2011			2011-2012		
	Cumin yield kg/ha	Total water applied (ha cm)	water productivity kg grain/ha cm irrigation water	Cumin yield kg/ha	Total water applied (ha cm)	water productivity kg grain/ha cm irrigation water
Irrigation methods						
Surface (Flood)	114.2	19.44	6.0	258.7	30.61	8.43
Drip	200.0	5.12	39.1	439.0	10.64	41.28
Micro Sprinkler	291.9	5.43	53.8	337.8	15.55	21.73
CD at 5%	106.6	2.03	18.8	94.2	3.07	16.41
Land Configuration						
Flat bed	149.8	10.73	24.8	274.6	19.62	18.26
Raised bed (75 cm)	243.1	8.81	41.4	479.4	17.68	33.39
Raised bed (150 cm)	213.2	10.45	32.5	281.5	19.49	19.78
CD at 5%	55.8	NS	10.2	48.3	NS	9.72